



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

T. YAMAGUCHI, et al : Group Art Unit: 1745

Application No. 09/936,148 : Examiner: Laura S. WEINER

Filed: September 7, 2001 :

For: ELECTROLYTE MEMBRANE FOR FUEL CELL AND MANUFACTURING  
METHOD THEREOF

DECLARATION UNDER 37 C.F.R. §1.132

Honorable Commissioner of Patents and Trademarks  
Washington, D.C. 20231

Sir:

I, Takeo YAMAGUCHI, do declare and state as follows:

I graduated from The University of Tokyo with a Doctor's  
Degree of Chemical Engineering in March 1993;

I became a post doctoral research fellow at department  
of Chemical Engineering, University of Colorado at Boulder  
in April, 1993, and since that time I have been engaged in  
research and development in the field of membrane science and  
technology and polymer electrolyte fuel cells at Department  
of Chemical System Engineering, University of Tokyo;

I am a co-inventor of the subject matter disclosed and

claimed in the above-identified application; and

I am familiar with the Office Action of August 23, 2005, and understand the Examiner's rejections.

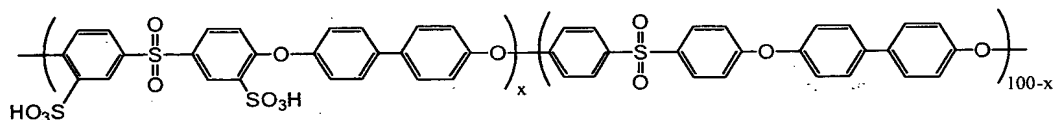
The following additional comparative experiment (Comparative Experiment B) was carried out by me or under my supervision, in order to make the differences between the subject matter and cited references more clear and to make advantages of the subject matter more clear.

Comparative Experiment C:

Materials used:

- 1) Filing Polymer: Sulfonated polyether sulfone (SPES) represented by following formula wherein X = 50 mol%; and

SPES Polymer



- 2) Porous substrate: Porous polyimide substrate (Porosity: 45 %; Pore size: 300 nm; Thickness: 45  $\mu$ m).

Experimental method:

Pre-synthesized SPES polymer represented by the above

formula was dissolved in organic solvent, and in the resulting solution, the above porous polyimide substrate was immersed, to fill the SPES polymer in the pores of the porous polyimide substrate. The resulting membrane in which the SPES polymer was filled in the pores of the porous polyimide substrate was used for following leaching experiment:

#### Leaching Experiment:

1) From the resulting membrane, some membrane pieces having the size of 15 mm x 15 mm were prepared.

2) Filling ratio was measured from the weight of the membrane pieces.

3) The membrane pieces were immersed in any one of the following solvents under the temperature of 80 °C for two hours:

Solvents used: a) Pure water; b) methanol-water mixed solvent (methanol concentration: 30 % by weight); and c) N-methylpyrrolidone (NMP).

4) After immersion, each of the membrane pieces was washed with pure water, and dried in vacuo under the temperature of 80 °C for three hours.

5) Filled polymer remained in each of the membrane pieces was measured by the change of weight between after- and before-immersion.

6) Each of the membrane pieces of after- and before-immersion was measured by FT-IR measurement, to identify

peak derived from a sulfonic acid group in SPES polymer.

# Results:

Results are summarized in Table 1.

Table 1. Results of leaching experiment

<b>Before</b> immersion	Membrane	Substrate	Filing Polymer	Filing ratio	Ratio of decreased polymer
	[mg]	[mg]	[mg]	[%]	[%]
Water	9.55	7.34	2.22	30.2	-
MeOH 30 wt %	9.20	7.34	1.87	25.42	-
NMP	9.02	7.34	1.69	23.0	-

<b>After</b> immersion	Membrane	Substrate	Filing Polymer	Filing ratio	Ratio of decreased polymer
	[mg]	[mg]	[mg]	[%]	[%]
Water	8.52	7.34	1.19	16.2	-46.5
MeOH 30 wt %	8.36	7.34	1.03	14.0	-45.0
NMP	7.29	7.34	-0.05	0	-100

Table 1 shows that SPES polymer in pores of the membrane prepared by the applying method were leached out in a good solvent such as water, water-MeOH mixed solvent, or NMP.

#### Conclusions

Polymers according to the applying method as described in the above comparative experiment C or Formato et al. (USP No. 6,248,469) are easily leached out when the membrane comprising the polymers in pores thereof is immersed in good solvent for the polymers, since the polymer, in particular, one end of each of the polymers is not bound to surface of pores of the membrane. On the other hand, polymers according to the present invention were not leached out, since the polymer, in particular, one end of each of the polymers is bound to surface of pores of the membrane.

In brief, Formato et al. (USP No. 6,248,469) does not disclose nor suggest one of features of the present invention, i.e., "a polymer is chemically bound to a surface of a pore", in particular, "one end of a molecule of polymer is bound to a surface of the pore".

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful

false statements and like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

DATE: September 4, 2006

Takeo Yamaguchi

Takeo Yamaguchi